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A SYSTEM OF PHYSICAL CHEMISTRY.

A System of Physical Chemistry. By Prof. W. C. McC. Lewis. Two vols. Vol. i., pp. xiv + 523. Vol. ii., pp. vii + 552. (London: Longmans, Green and Co., 1916.) 9s. net each vol.

PHYSICAL chemistry in the present-day sense of the term may be said to date from 1887, the year in which Ramsay came to London, Ostwald was appointed to the chair in Leipzig, and the *Zeitschrift für physikalische Chemie* was founded by Ostwald and van't Hoff. Although many pioneers, amongst whom may be mentioned Deville, Debray, Guldberg and Waage, Gibbs, Horstmann, Berthelot, Thomson, Harcourt and Esson, Gladstone, Le Chatelier, and Lemoine had prepared the way for the new development in chemical science, it was the combined influence of van't Hoff, Arrhenius, Ostwald, and Ramsay that gave direction and strength to the new current of thought and research.

It is a remarkable fact that during this period of nearly thirty years the English-speaking peoples of the world have had to depend chiefly on works written in German, or their translations into English, for the accepted standard treatises on the subject. The "Lehrbuch" of Ostwald, the "Theoretische Chemie" of Nernst, and the "Vorlesungen" of van't Hoff were for many years without a serious competitor. A change in this state of affairs was brought about by the appearance of the excellent series of "Text-books of Physical Chemistry" edited by Sir William Ramsay. But as these were mostly in the nature of special treatises on different branches of the subject, the student desirous of obtaining a compact and rounded, and at the same time fairly comprehensive, view of physical chemistry as a whole had still to have recourse to the works previously mentioned. Yet none of these was entirely satisfactory. Ostwald's "Lehrbuch," though unexcelled in its historical treatment of the subject, was too cumbersome, was marred by its author's unfortunate attempt to "energeticise" thermodynamics, and has not been kept up to date. Nernst's otherwise excellent treatise repelled the student by its opening chapters, which presented the subject of thermodynamics in a Helmholtzian form unfamiliar to English students, but so generalised, so condensed, and so careless in reasoning that few students could separate the gold from the dross. Finally, the lectures of van't Hoff, though the work of a master-hand, scarcely covered the required field of study in a sufficiently comprehensive manner.

The present work, which appears as the latest volume of Sir William Ramsay's series of text-books, differs radically from its predecessors inasmuch as it essays to present the reader with a fairly comprehensive "System of Physical Chemistry." In this respect it is worthy of especial consideration and attention. It may be said at once

that in its arrangement of matter, lucidity of style, and comprehensive unity of design it is destined to become the standard general treatise on the subject of physical chemistry for English-speaking students.

The frontispiece consists of a table indicating a "philosophical" classification of the subject. This is very interesting, and will be of great service in giving the student a reasoned survey of the field to be traversed. The main division is into systems in equilibrium and systems not in equilibrium. The subdivision of these is based partly on the nature of the subject-matter and partly on the method of treating it. This want of uniformity in the system of classification is, however, no defect, as it corresponds to the natural development of science. The author is to be congratulated on this emphasising of the philosophical aspect of his subject, an aspect which is all too frequently ignored by the authors of scientific treatises. For practical purposes the work is divided into two volumes. Vol. i. deals with the subject from the classical kinetic-molecular point of view. Vol. ii. is divided into two parts, part i. being entitled "Considerations based upon Thermodynamics," and part ii. "Considerations based upon Thermodynamics and Statistical Mechanics."

This method of division has a philosophical and historical as well as a practical didactic basis. As Perrin has pointed out in the beautiful preface to "Les Atomes," there are two methods by means of which the human mind advances in its understanding of the external world. In one case "on généralise des résultats d'expérience, mais les raisonnements ou les énoncés ne font intervenir que des objets qui peuvent être observés ou des expériences qui peuvent être faites." This is essentially the method of the "classical" thermodynamics, on which so much of the science of physical chemistry is based. But there is also another method—"deviner l'existence ou les propriétés d'objets qui sont encore au delà de notre connaissance, expliquer du visible compliqué par de l'invisible simple, voilà la forme d'intelligence intuitive à laquelle, grâce à des hommes tels que Dalton ou Boltzmann, nous devons l'Atomistique." It is to this that we owe not only the beginnings of chemical science, but also the latest advances. The trend of modern physical chemistry is largely in the direction of "Atomistique."

The author's presentation of the subject has also an important didactic advantage. Students invariably find chemical thermodynamics difficult, but read with comparative ease an exposition based on a simple kinetic-molecular method of treatment. In vol. i. they will find the latter, enlivened and brought up to date by an account of the work of Einstein, Perrin, and Svedberg on "molecular reality," and a discussion of the electron theory of matter, the structure of the atom, and the transmutation of the elements. Part i. of vol. ii. contains a good account of the thermodynamical treatment of chemical problems, includ-

ing the application of thermodynamics to electro-chemistry, and the "Nernst Theorem." In part ii. the author discusses photo-chemistry, the theory of radiation, and the application of the theory of Quanta to the problems of photo-chemistry, radiation, and the kinetic theory of matter. These highly important aspects of what one might term the "newer physical chemistry" are dealt with in a very simple and clear fashion, and this part of the book will be exceedingly valuable to students of chemistry.

During the last decade the scope and importance of physical chemistry have become enormously increased. To write within moderate compass a good text-book on the subject has become a task of rapidly increasing difficulty. Nevertheless Prof. Lewis has achieved this task with an admirable success. One might say of him, "Jeunesse savait, jeunesse pouvait."

F. G. DONNAN.

THE FLORA OF ALL AFRICA.

The Flowering Plants of Africa: An Analytical Key to the Genera of African Phanerogams. By F. Thonner. Pp. xvi+647. (London: Dulau and Co., Ltd., 1915.) Price 15s. net.

THE work under notice is a translation of the author's "Die Blütenpflanzen Afrikas," which appeared in 1908. The preface is dated Vienna, Austria, 1913, and the work was issued by the Burleigh Press, Bristol, in 1915. Dr. A. B. Rendle revised the translation, which includes "diagnostic characters of the genera, the approximate number of African species described up to the end of the year 1910; their geographical distribution, their uses, and their more important synonyms." So far as tested, it is up to the date named; but six years' additions are very considerable, Kew alone having published at least 300 new species, leaving new genera out of the question. But comprehensive compilations necessitate supplements if they are brought as nearly as possible up to date of publication; and Thonner gives six pages of corrections and additional genera, chiefly from the years 1911 and 1912.

The descriptive part of the work occupies about 550 pages, and the general distribution of the genera enumerated is set forth in a statistical table. It should be understood that only families and genera are described, and the classification is Englerian. The area embraced includes all the African islands, from the Azores to Tristan da Cunha, and Socotra, the Mascarenes, and Madagascar to Kerguelen. And the geographical divisions of the mainland are physical rather than political. Thonner's enumeration and estimates afford a record of 226 families of flowering plants indigenous in the African region, and represented therein by 3551 genera and 39,800 species, or say 40,000. His estimate for the world is 10,055 genera, with a total of 144,500 species, and his figures are certainly not too high. The table also shows the numbers for North, Central, and South Africa, and the Malagasy Islands.

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Other features of the book are: a condensed bibliography, a glossary, indexes to the popular and botanical names, and a list of the plates and the abbreviations of authors' names. The plates are excellent, and represent members of 150 families, and the letterpress is clear and idiomatic. Wherever possible the author has chosen as distinctive characters such as are visible to the naked eye in a plant in flower. First comes a key to the families, followed by descriptions of the same, and under each a key to its genera, including a considerable number of introduced plants. The plan and scope of the work have been somewhat fully explained, because that seemed a more useful course than a technical criticism. Its full value can only be determined by actual use; but an elementary knowledge of external morphology and descriptive terminology would be necessary and sufficient to enable the student to understand the treatment of the subject. As a book of reference only it answers many interesting questions.

W. BOTTING HEMSLEY.

CHRISTIANITY IN PARTIBUS.

The Nestorian Monument in China. By Prof. P. Y. Saeki. Pp. x+342. (London: Society for Promoting Christian Knowledge, 1916.) Price 10s. 6d. net.

THIS volume deals with one of the most interesting romances of literature ever known. The story has often been told before; but it will bear repetition, on the chance of reaching some whose reading may have lain in other directions.

The Christian religion, under the guise of what is now known as the Nestorian heresy, was carried to China early in the seventh century A.D. by a mission dispatched under the auspices of adherents who had been for some time seeking in the Far East the development which was denied to them in the West. Nestorius had been appointed Patriarch of Constantinople in A.D. 428, but in an evil moment for himself he conceived the idea that all difficulties as to Christ's birth would vanish if it were understood that He had distinct human and divine persons. For this he was deposed in 431, and a few years later he disappeared.

Nestorianism survived its founder for many centuries. Reaching China in the year 631, its advance was so rapid that by 635 Nestorian missionaries were allowed to settle at the capital, where for a couple of centuries they enjoyed Imperial protection and even patronage. In 781 the Nestorian Church of the day set up a huge stone tablet, more than 9 ft. in height, more than 3 ft. in breadth, and about a foot thick. On this tablet an inscription was carved, in Chinese and Syriac, explaining and glorifying the Christian religion, and celebrating the praises of the great and good Emperors who had permitted this teaching to take root and flourish. For flourish it unmistakably did, and so it was found in the thirteenth century by Marco Polo. Then, during the fourteenth century, it faded away, leaving no